PB86-[illegible]

Field Inspection Guidance for Monitoring Total Reduced Sulfur (TRS) from Kraft Pulp Mills

Engineering-Science, Inc., Durham, NC

Prepared for

Environmental Protection Agency, Washington, DC

Dec 84

U.S. Department of Commerce
National Technical Information Service
NTIS.

United States
Environmental Protection
Agency

Office of Air Quality
Planning and Standards
Washington, D.C. 20460

EPA-340/1-85-019
December 1985

Stationary Source Compliance Series

EPA

Field Inspection Notebook for Monitoring Total Reduced Sulfur (TRS) from Kraft Pulp Mills

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

1. REPORT NO. [illegible]	2. [illegible] PB 81-163 [illegible]
4. TITLE AND SUBTITLE Field Inspection Notebook for Monitoring Total Reduced Sulfur (TRS) From Kraft Pulp Mills	5. REPORT DATE December 1980 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) William F. "Jerry" Kimbrough, Jr.	8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Engineering-Science 501 Willard Avenue Durham, NC 27701	10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO. 68-02-3060
12. SPONSORING AGENCY NAME AND ADDRESS Stationary Source Compliance Division Technical Service Branch Waterside Mall, 401 M Street, S.W. Washington, DC 20460	13. TYPE OF REPORT AND PERIOD COVERED 14. SPONSORING AGENCY CODE
15. SUPPLEMENTARY NOTES Supplements Technical Assistance Document for Monitoring Total Reduced Sulfur (TRS) From Kraft Pulp Mills; EPA Task Manager-Sonya Blalock, (303) 783-2811	

16. ABSTRACT

Field performance audit procedures were developed for three of the most common total reduced sulfur (TRS) continuous emission monitoring systems (CEMS). These procedures were designed to assist state/federal field inspectors in the evaluation of TRS-CEMS. Contained in the notebook are checklists and data entry tables covering preparation for the inspection, preliminary review of records, preliminary on-site meeting with source personnel, and general guidelines for inspection of any type TRS-CEMS. Specific audit procedures for three of the most common models of TRS CEMS

- Sampling Technology Inc. Model 100 TRS CEM System;
- Barton Titrator TRS System; and
- Bendix Gas Chromatograph TRS System

are provided as sectional inserts. In auditing these monitors the inspector should follow the specific procedure rather than the general guidelines given in the body of the field notebook.

Conscientious use of this notebook will aid the inspector in conducting a thorough audit of the TRS CEMS and provide a comprehensive original record of all phases of the inspection.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Pollution Monitoring Kraft Pulp Mills Continuous Emission Monitoring	Opacity Monitoring Systems Audit Procedures TRS Continuous Emission Monitors	

18. DISTRIBUTION STATEMENT Release to Public	19. SECURITY CLASS (This Report) Unclassified	21. NO. OF PAGES 109
	20. SECURITY CLASS (This page) Unclassified	22. PRICE $6.95

EPA Form 2220-1 (Rev. 4-77) PREVIOUS EDITION IS OBSOLETE

EPA-340/1-86-010

Field Inspection Notebook for Monitoring Total Reduced Sulfur (TRS) from Kraft Pulp Mills

Prepared by
William T. Winberry, Jr.

Engineering-Science
501 Willard Street
Durham, North Carolina 27701

Contract No. 68-02-3960
Work Assignment No. 53

EPA Project Manager: John Busik
EPA Work Assignment Manager: Sonya M. Stelmack

U.S. ENVIRONMENTAL PROTECTION AGENCY
Stationary Source Compliance Division
Office of Air Quality Planning and Standards
Washington, D.C. 20460

December 1984

[redacted]

TABLE OF CONTENTS

Subject	Page Number
Introduction	1
Public Inspection Reference Objective	1
Inspection Procedures	1
Level I	1
Level II	11
Level III	40
Material Specific Inspection Procedures	51
Composite Technology 101	51
Carbon Fiberglass	51
Kevlar 101 USA System	51
Level IV	61
Reference Method 10 Observation Checklist	61
Reference Method 100 Observation Checklist	61
Abbreviated Inspection Procedures	67
Appendix	109

[illegible]

[illegible]

[illegible] notebook is designed to assist the field inspector in the conduct of hybrid cathode-ruffle (HCR) continuous emission monitoring system (CEMS). Contained in the notebook are selective QA data, data recording preparation for the inspection, performance check of records, performance acceptance testing and source assessment. QA general guidelines for inspection of any type HCR CEMS system. Specific QA/C procedures for three of the most common models of HCR CEMS:

- Sampling Technology Inc., Model CCX 700 HCR System (pg. 30);
- Durham Precision HCR System (pg. 51); and
- Sensors Inc. Microphotograph HCR System (pg. 61)

are provided as sectional inserts. In putting these sections the inspector should follow the specific procedure rather than the general guidelines given in the body of the front notebook.

Conscientious use of this notebook will aid the inspector in conducting a thorough audit of the HCR CEMS system and provide a comprehensive original record of all phases of the inspection.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[redacted]

o PST Summary Results

	TRS	O_2	Opacity
Relative Accuracy		NA	NA
Response Time			
24 Hr. Span Drift			
24 Hr. Zero Drift			

1.2.5 Review of Excess Emissions Reports

o The following checklist summarizes pertinent information to be obtained from excess emissions reports.

Months covered by reports _____

Did each excess emission report document:

Date, time, and duration of excess emissions? Yes___ No ___

Magnitude of excess emissions? Yes___ No___

Reason for excess emissions? Yes___ No___

Corrective action taken to reduce emissions? Yes___ No___

Conversions factor/formula? Yes___ No___

Method for determining conversion or correction factors used in calculating emission rate.

_____

_____

_____

_____

Process downtime_____ None _____

Monitor downtime_____ None _____

If significant monitor downtime occurred, briefly discuss corrective action taken to return monitor to operation.

_____

_____

What percent availability did the CEM system achieve?_____

$$\% \text{ availability} = \frac{\text{Hours of monitor operation}}{\text{Hours of process operation}}$$

o Select one excess emission event and record:

Date _____

Time _____

Magnitude _____

Reason _____

Corrective Action _____

This information is intended for use during Level II evaluation.

2.0 LEVEL II CHECKLIST

2.1 PRE-INSPECTION MEETING

Before the CEM inspection, the inspector should arrange to meet with source representatives directly responsible for CEM operation and maintenance, compliance, records and reports. The purpose of the opening conference is to inform facility official(s) of the purpose of the inspection, the authority under which it wil be conducted, and the procedures to be followed, and answer any questions they may have. The opening conference also offers the inspector the opportunity to completely discuss agency policy and inspection procedures, and to provide relevant information and other assistance. The inspector's effective execution of the opening conference often sets the tone of the remainder of the inspection.

During the opening conference, the discussion should cover the following items:

	COVERED
o Inspection objectives	_____
o Inspection agenda	_____
o Facility Information verification	_____
o Review of records	_____
o Maintenance	_____
o CEM Operation Logbook	_____
o Strip Charts	_____
o Data Log	_____
o Control Equipment Records	_____
o Excess Emission Reports	_____
o Source Permit	_____
o Safety Requirements	_____
o Scheduling of Source Personnel Interviews	_____
o Inspection Techniques to Be Used	_____
o Scheduling of Copying Needed Documentation	_____
o Any Questions	_____

In particular, the inspector should develop his or her understanding of the operation/maintenance of the audited system to ascertain whether the TRS CEM system has been operated according to permit condition since the last inspection. The inspector should be able to support any conclusions by:

- o Examination of CEM maintenance records;
- o CEM span and zero calibration checks over previous quarter;
- o Reviewing the CEM program;
- o Records comparison, i.e., correlation of excess emission reports, strip chart records, operations and maintenance records, and computer printouts (if available); and
- o Reviewing files to identify missing documents (if any).

The following checklists are provided to assist the inspector in conducting the preliminary meeting.

2.1.1 Personnel In Attendance

Name	Affiliation	Title/Responsibility	Phone Number

2.1.2 Review of CEM Maintenance Records.

o Describe significant CEM maintenance since last audit.

Description	Type*	Date/time Performed

*Routine, Preventive, Emergency, etc.

o Recurring Maintenance Problems (Last 12 Months)

2.1.3 Review of Calibration Frequency

	Zero	Span	Calibration Error*	Relative Accuracy*
Estimate of Calibration Frequency	____	____	____	_____

*Optional

o Describe Unusual or Persistent Monitor Calibration problems

7.1.4 General Review of CEM Program

- o Is an alarm connected to CEM control panel or annunciator panel in process control room to signal excess emissions? Yes___ No___
- o How often is CEM strip chart or computer output checked by an operator?

  _____

- o What procedures are implemented during an excess emission incident to reduce emissions?_____

  _____

  _____

  _____

  _____

  _____

  _____

  _____

- o Do records contain process data needed for conversion of CEM output to units of the standard (i.e., moisture, velocity, oxygen correction)? Yes___ No___
- o Are process data measurements conducted? Yes___ No___
- o Do records contain current information on calibration reference materials (gases, permeation tubes, cells, filters)? Yes___ No___
- o Are entries into Maintenance and Operations Logs made on monitor:

  Malfunction? Yes___ No___

  Calibrations? Yes___ No___

  Maintenance? Yes___ No___

  QA Checks? Yes___ No___

- o Are charts/printouts for the past two years filed and readily retrievable? Yes___ No___

2.1.5 Internal Consistency of Records and Reports

It should be possible to relate the emission excusions reported in the Excess Emissions Report with the recorded CEM datashowing the occurrence of excess emissions. Such excursions should als: be documented in the CEM Log, which should include a report of the incient and the corrective action taken by the source. In those cases wherea mechanical problem is cited as the cause of the excess emissions, maintennce records should show corrective action taken by the source. The inspetor should try to determine the time between the measured excess emissions incident and the initiation of corrective action.

- Report of Excess Emissions (Enter data from Level I Review)

Date	Time From	Time To	Pollutant	$\%O_2$	Magnitude (ppm)

- Description of Excess Emissions from CEM or operating Log on above date.

_____

_____

- Identification of Excess Emissions Incident in Chart Record

Above Date	Time	Last Zero Check	Last Span Check	Average (ppm)	Calculated equivalent (ppm) (O_2 corrected)

- Subsequent Corrective Action Described in Mainterance Log (if applicable), and date and time initiated

_____

_____

- Are dates and times of above records consistent in recording this excess emission event? Yes___ No___
- If No, explain_____

_____

_____

_____

2.2 TRS CEM FIELD INSPECTION

The general inspection procedures presented on the following pages cover extractive TRS CEM systems. These procedures should be followed when a monitor-specific procedure is unavailable.

Check or Comment

2.2.1 TRS CEM Operational Environment

- o Is the process monitored by the TRS CEM operating within normal limits as compared to the source performance test? Yes___ No___ _____

  (If process is not operating within normal limits, inspector should delay any part of audit which requires normal process conditions.)

- o Process Capacity _____ _____

- o Process Rate _____ _____

- o Stack Gases Monitored: TRS_____ Opacity_____ _____

  (Avg. Conc.) O_2_____ _____

- o Stack Gas Temperature_____°F _____

- o Pollution Control Device_____ _____

- o Is the analyzer unit subject to excessive heat? Yes___ No ___ _____

- o Is the analyzer unit subject to excessive vibration? Yes___ No ___ _____

  [Note: Excessive heat/vibrations are meaningful only if system (1) fails to satisfy the operations specified by vendor or (2) fail to meet PST 5.]

- o Frequency of sampling: _____per hour_____ _____

2.2.2 Measurements and Data Handling

The following checklists are intended to assist the inspector in an analysis of the source's data handling and data reduction practices.

At some facilities data reduction is done by a computer programmed to convert stack gas concentrations directly and continuously to the units of the applicable emission standard. At other facilities manual calculations of emissions in units of the standard are only done for periods of excess emissions.

Preceding page blank

Check or Comment

2.2.2.1 Data Handling

- How is data reduction handled? Manually _____ _____
  Electronically _____ _____
- How many data points are used to calculate each average? _____ _____
- Are these data points taken at equally spaced time intervals? _____ Yes ___ No ___ _____
- If yes, what is that time interval? _____ _____
- If data reduction is manual, how often is it done? _____
  _____
- Who performs manual data reduction? _____ _____
  _____
- Are the data adjusted to account for zero drift measurements? _____ Yes ___ No ___ _____
- Are the data corrected to account for calibration (span) drift measurements? _____ Yes ___ No ___ _____
- Does the source arbitrarily edit the data before reduction? _____ Yes ___ No ___ _____
- If yes, what criteria is used to edit? _____ _____
  _____
  _____
  _____

2.2.2.2 Electronic Data Reduction:

- Who wrote the program for calculating averages? _____
  _____
  _____
- Is the source's data processing system time shared or dedicated? _____ _____
- Was it installed with the monitoring system or added at a later date? _____ _____

Check or Comment

- Who installed the data processing system? _____ _____

  _____

- At what interval does the data logger acquire CEM measurements? _____ _____

  _____

- Does the system include a data recorder as well as a chart? _____ Yes ___ No___ _____

- If yes, indicate which kind. Magnetic tape _____ _____
  Paper tape _____
  Paper print-out _____

- If both automated data processing and chart recording are done, does the CEM value from the automated data processor agree with the value recorded on the chart? Yes ___ No ___ _____

- If no, explain. _____ _____

  _____

  _____

- Indicate which functions the automated data processing system performs. _____

  Data recording _____

  Data storage _____

  Averaging Period _____

  Hourly summary _____

  Daily summary _____

  Other summary (explain) _____

  _____

  Identification of excess emissions _____

  Display instantaneous value _____

  Alarm _____

Check or Comment

Records process equipment malfunction codes _____

Records pollution control equipment malfunction codes _____

Records excess emission codes _____

7.0.0.3 Internal Zero/Span Check

- Write date and time on chart or data processor at start of inspection _____
- Record current emissions

	TRS (ppm)	O_2 (%)	Opacity (%)
Current Emissions	_____	_____	_____

- Request internal zero and upscale calibration, enter results below, and compare results to typical previous values.

Monitor Response	_____	_____	_____
Zero	_____	_____	_____
Span	_____	_____	_____
Calibration Value			
Zero	_____	_____	_____
Span	_____	_____	_____

- Review previous day's recording for typical emissions, repeated zero/span checks, etc. _____

	Yes	No
Emissions normal	_____	_____
Calibration normal	_____	_____
Exceedances above the standard	_____	_____
Calibrations noted on data processor and reviewed	_____	_____
Operator aware of emission limits	_____	_____

Check
or
Comment

2.2.3 Inspection of Monitor Control Unit

Although instrumentation differs among the various types and models of TRS CEM's, many will incorporate some or all of these control indicators or switches. The inspector should locate those in use and enter their position/status below.

	TRS	O_2	Opacity	
o Reference				
o Calibration				
o Alarm				
o Temperature				
o Sample gas				
o Stack gas				
o Heater				
o Backpurge				
o Request Calibration				
o Operating Range				
o Recorder Readout				
o Operate				
o Sample Flow Rate				

2.2.4 Calibration Gas System

o If system uses compressed gases to routinely calibrate system, note following gas cylinder information:

Gas Cylinder 1

Pollutant _____

Concentration _____

Certification Date _____

Cylinder Number _____

Cylinder Pressure (psi) _____ primary (>150psi)

_____ secondary (> 15psi)

Gas Cylinder 2

Pollutant _____

Concentration _____

Certification Date _____

Cylinder Number _____

Cylinder Pressure (psi) _____ primary (>150psi)
_____ secondary (> 15psi)

Gas Cylinder 3

Pollutant _____

Concentration _____

Certification Date _____

Cylinder Number _____

Cylinder Pressure (psi) _____ primary (>150psi)
_____ secondary (> 15psi)

Gas Cylinder 4

Pollutant _____

Concentration _____

Certification Date _____

Cylinder Number _____

Cylinder Pressure (psi) _____ primary (>150psi)

_____ secondary (> 15psi)

Check if Completed

2.2.5 Sample Transport System

- Type of tubing _____
- Internal diameter of tubing _____ inches
- Enter the distance from sample point to analyzer _____ feet
- Is transport line heat traced? ___ Yes ___ No
- If yes, how is temperature monitored? _____

_____

_____

- Enter the temperature of the transport line:

_____

2.2.6 Sample Conditioning/Extractive Systems

For extractive systems the following checklists describe the sampling point, transport system, and sample conditioning system.

2.2.6.1 Sampling Point -

- Location: Stack _____

  Duct Horizontal _____

  Duct Vertical _____
- Is it downstream of pollution control device? Yes ___ No ___
- Type pollution control device(s) _____
- Estimate distance from nearest flow disturbance and record below.

  Downstream: _____ feet

  Upstream: _____ feet
- Sketch the cross-section of the duct/stack at the sampling point and show the location of the sampling probe of CEM. Indicate dimensions.

Sketch of Duct/Stack and Sampling Probe Location

Check or Comment

- On the following blank page sketch the components of the Extractive CEM, including the probe, filter, calibration gas interface, pump, moisture removal system, SO_2 scrubber system (where applicable), and analyzer. _____

2.2.6.2 Sample Probe -

- Type Material: _____ _____
- Singular or multi-point sampling? _____ _____
- If multi-point sampling, enter number of sampling points _____ _____
- Distance of each point from the wall: _____

Point No.	1	2	3	4	5	6	7
Inches from wall	___	___	___	___	___	___	___

- If single point, enter distance from wall: ___ inches _____

Sketch of the Components of the Extractive CEM, Including the Probe, Filter, Calibration Gas Interface, Pump, Moisture Removal System, SO_2 Scrubber System (where applicable), Analyzer, and Calibration System.

Check or Comment

2.2.6.3 Filter -

- o Type: Internal _____ External _____ _____
- o Condition: _____ _____
- o Is there a back purge on the sampling system to clean the probe? _____ Yes___ No___ _____
- o If yes, how often is it activated? _____ _____
- o Is the purge air dried prior to use? Yes___ No__ _____
- o Frequency of Replacement: _____ _____
- o Typical pressure drop across filter (if monitored): _____ _____
- o Current pressure drop across filter (if monitored): _____ _____

2.2.6.4 Moisture Removal (if applicable): -

- o Type of moisture removal equipment? _____ _____

  Refrigerated or tube type condenser _____

  Permeation dryer _____
- o Location: _____ _____
- o Sample Gas Temperature at Outlet During Audit: _____ _____

2.2.6.5 Sample Pump -

- o Type: _____ _____
- o Location: _____ _____
- o Flow Rate: _____ _____

2.2.6.6 Heater/Oven (if applicable) -

- o Location: _____ _____

  _____
- o Temperature of Gas at Outlet During Audit (if monitored) _____ _____

Check or Comment

2.2.6.7 SO_2 Scrubber System -

- o Location: _____ _____
  _____
- o Type: _____ _____
  _____
- o Frequency of change _____ _____
  _____

2.3 CLOSING CONFERENCE

The closing conference enables the inspector to "close-out" the inspection with plant personnel. At this time, questions can also be answered relating to results of the inspection. In general, the following elements should be covered in the closing conference:

- o Review of Inspection Data ____ _____
- o Inspection Discussion ____ _____
- o Confidential Information ____ _____
- o Deficiencies in monitoring program ____ _____
- o Recommendations ____ _____

3.0 LEVEL III CHECKLIST

3.1 INTRODUCTION

The Level III inspection, for the State inspector, is the most costly and labor intensive. Level III inspection becomes necessary only when the Level II inspection indicates deficiencies in the CEM system. The Level III inspection involves a complete evaluation of the monitoring system through a dynamic calibration procedure. Multiple concentration gases are injected, as close to the probe tip as possible, and the monitor response is compared to the certified gas values. From this evaluation, a calibration error is determined. If the error falls outside calibration drift performance specification values, then the monitoring system is "out-of-control." This would necesitate some form of corrective action.

3.2 CYLINDER GAS AUDIT

Check or Comment

3.2.1 Attach the proper gas line from the certified gas cylinder to as close to the probe tip as possible. Properly adjust the flow rate to manufacturers' specifications.

3.2.2 List Certified Gases _____

Gas Mixtures:

	Pollutant		
	TRS	O_2	Other
Gas A _____ppm/%			
Cylinder No. _____			
Certification Date _____	____	____	____
Pressure (psi) _____ Initial _____ Final			
Gas B _____ppm/%			
Cylinder No. _____			
Certification Date _____	____	____	____
Pressure (psi) _____ Initial _____ Final			

Preceding page blank

Gas C _____ppm/%

Cylinder No. _____

Certification Date _____ ____ ____ ____ _____

Pressure (psi) _____ _____
Initial Final

Check or Comment

3.2.3 Inject each gas into the monitoring system, as close to the probe tip as practical. Record monitor response on Level III Field Data Sheet. _____

3.2.4. Calculate % Difference for each calibration gas by the following equation: _____

$$\% \text{ Difference} = \left[\frac{(\text{Avg. Monitor Response}) - (\text{Audit value})}{(\text{Audit Value})} \right] \times 100$$

LEVEL III
FIELD DATA SHEET
PERCENT DIFFERENCE DETERMINATION

Person Conducting Audit _____ Analyzer Manufacturer _____
Affiliation _____ Model/Serial No. _____
Date _____ Location _____

Audit Gas Concentration	Pollutant	Certification Date	Expiration Date
Low-Range			
Mid-Range			
High-Range			

Run Number	Audit Gas Concentration	Instrument Response	Arithmetic Difference		
			Low	Mid	High
1-Low				-	-
2-Mid			-		-
3-High			-	-	
4-Low				-	-
5-Mid			-		-
6-High			-	-	
7-Low				-	-
8-Mid			-		-
9-High			-	-	
10-Low				-	-
11-Mid			-		-
12-High			-	-	
13-Low				-	-
14-Mid			-		-
15-High			-	-	-
		Arithmetic Mean			

3.3 MONITOR-SPECIFIC INSPECTION PROCEDURES

If calibration gases are not available, the inspector can evaluate the installed TRS CEM system through monitor-specific inspection procedures. This involves observing various operating parameters as indicated by valves, meters, pressure gauges or switches. Observed values are then referenced to the "baseline" values established during monitor certification.

To assist the inspector, monitor-specific inspection procedures have been developed for three commercially available TRS monitoring systems. They are:

- Sampling Technology Inc. TRS CEM Model 100;
- Barton Titration TRS CEM System; and
- Bendix Gas Chromatograph TRS CEM System.

To insure that all information is obtained in an orderly fashion, the procedures are presented in the order they are normally encountered in the field, i.e., analyzer/computer system; calibration system, transfer system and probe/conditioning system.

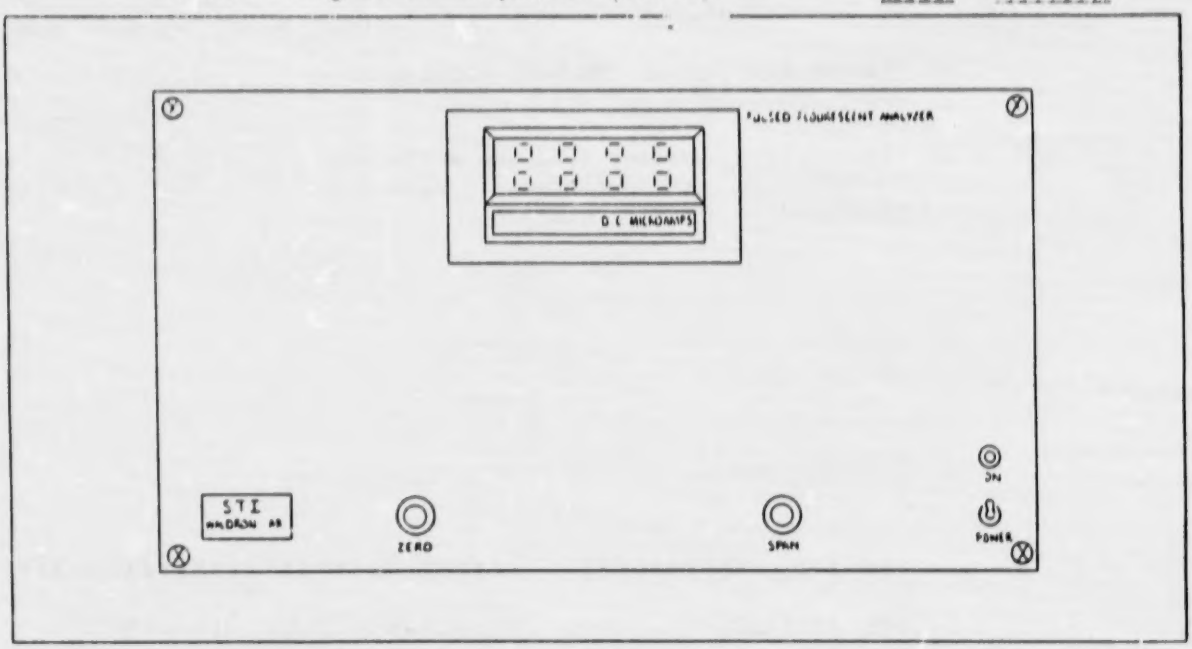
Preceding page blank

3.3.1 SAMPLING TECHNOLOGY INC. TRS CEM SYSTEM INSPECTION PROCEDURES

3.3.1.1 Analyzer Evaluation

Pulse Flourescence Analyzer

	Check	Comment
o Observe reading of SO_2 as displayed in window (reading is % of monitor range). Compare to CRT display and computer printout. (Review diagram for inspection points)	____	_____



o Observe that "on" light is illuminated.	____	_____
o Check positions of zero/span pots (potentiometer) and compare to maintenance logs.	____	_____

O_2 Analyzer

o Observe meter display and compare to CRT and computer printout.	____	_____
o Note position of "Range" switch.	____	_____

_____
Range

o Note "sample flow" as indicated by rotameter. (Should be between 400-500 cc/min).	____	_____

_____
cc/min

Preceding page blank

	Check	Comment

Computer

- o Observe that power light (yellow) on key board is flashing. _____ _____
- o Observe that power light (red) on screen display is on. _____ _____
- o Observe that printer "power on light" is illuminated. _____ _____
- o Observe that screen "format" is updated every 4-6 seconds. _____ _____
- o Observe last computer readouts of TRS and O_2 and compare to instantaneous values as displayed on monitor meters.

TRS	O_2
_____	_____
_____	_____
meter	meter

- o Observe previous 12 hour report (see sample). _____ _____

****

TRS 12 HOUR REPORT - 12:00:48 JULY 11 1984

12 HOUR [TRS/02 CORRECTED] AVERAGE VALUE (PPM)

RCVY BLR TRS	TRS	02
00:00 TO 01:00	.3	5.2
01:00 TO 02:00	.3	5.0
02:00 TO 03:00	.3	5.0
03:00 TO 04:00	.3	4.8
04:00 TO 05:00	.3	4.7
05:00 TO 06:00	.2	5.2
06:00 TO 07:00	.2	5.2
07:00 TO 08:00	.3	5.7
08:00 TO 09:00	0.0	0.0
09:00 TO 10:00	0.0	0.0
10:00 TO 11:00	2.3	6.9
11:00 TO 12:00	.1	14.8
UNCORRECTED TRS AVERAGE	.5	
02 CORRECTED TRS AVERAGE	.4	
02 AVERAGE	6.2	

where:

C_{corr} = the average concentration corrected for oxygen;
C_{meas} = the average concentration uncorrected for oxygen for previous 12-hours;
X = the volumetric oxygen concentration in percentage to be corrected to (8 percent for recovery furnaces and 10 percent for lime kilns, incinerators, or other devices); and
Y = the measured 12-hour average volumetric oxygen concentration.

	Check	Comment
o Review previous 24-hour printouts observing stack gas concentration variation and consistency.	____	_____
o Review previous 24 hour calibration drift report and compare to plant standard. (See printout below).	____	_____

HOURLY TRS REPORT 10:00:07 JULY 11 1984

	TRS(PPM)	TRS/02 CORR.	02	CORR/FAC
RCVY BLR IRS	0.0	0.0	0.0	0.0

75% DATA AVAILABLE FOR STREAM #1

o Initiate an internal "zero/span" check or monitor system. Compare to gas cylinder valves. ____ _____

TRS	O_2
Gas cylinder valves	Gas cylinder valves
Monitor response	Monitor response
% Off	% Off

o Request "Limits Factors" and compare to plant limits. ____ _____

- o O_2 STD_____
- o TRS_____
- o O_2 cal gas valve

	Check	Comment

Dilution Air Conditioning System

- o Open cabinet door. ____ _____
- o Insure pump is running with 30 lbs pressure. ____ _____
- o Air pressure regulator should indicate 60 lbs pressure. ____ _____
- o Listen to insure regenerative dryer working properly. ____ _____

Calibration Gas Cylinder

- o Check certification of gas cylinders valves and compare to maintenance logs and computer printout. ____ _____
- o Check cylinder numbers and compare to certification sheets. ____ _____
- o Observe primary/secondary pressure gauge and note setting. (Normal settings should be 300 psi primary and 40 psi secondary). ____ _____

Gas Cylinder #1

Concentration_____
Certificate date_____
Gauge settings

Primary_____
Secondary_____

Gas Cylinder #2

Concentration_____
Certificate date_____
Gauge settings

Primary_____
Secondary_____

Recorder

- o Observe emissions over previous day. ____ _____
- o Inspect previous zero/span readings and compare to gas cylinder valves. ____ _____

	Check	Comment

3.3.1.2 SO_2 Scrubber System (located behind monitor racks)

- o Check moisture level in reservoir. ____ ____
- o Observe that scrubber is regenerating in a timely fashion (15 minutes). ____ ____
- o Review maintenance logs for possible drift problems associated with scrubber system. ____ ____

  Positive Drift - Release of SO_2 from packing. ____ ____

  Negative Drift - Retention of SO_2 during daily zero/span check. ____ ____
- o Review maintenance logs for periodic changing scrubber sieves (30 day intervals). ____ ____

Thermal Oxidizer

- o Check temperature display on front of panel. Should be between 1500-1600°F. (825-875°C). ____ ____
- o Observe that power light is on. ____ ____
- o Review maintenance logs for periodic adjustments of thermal oxidizer temperature. ____ ____

Analyzer Rack

- o Check for power on. ____ ____
- o Check all pressure regulators and relate setting to initial monitor certification setting in maintenance logs. ____ ____
- o Check sample by-pass rotameter (should be 1-2 lpm. However, this number depends upon length of sample line. Initial valve should be recorded in log book during certification testing). ____ ____

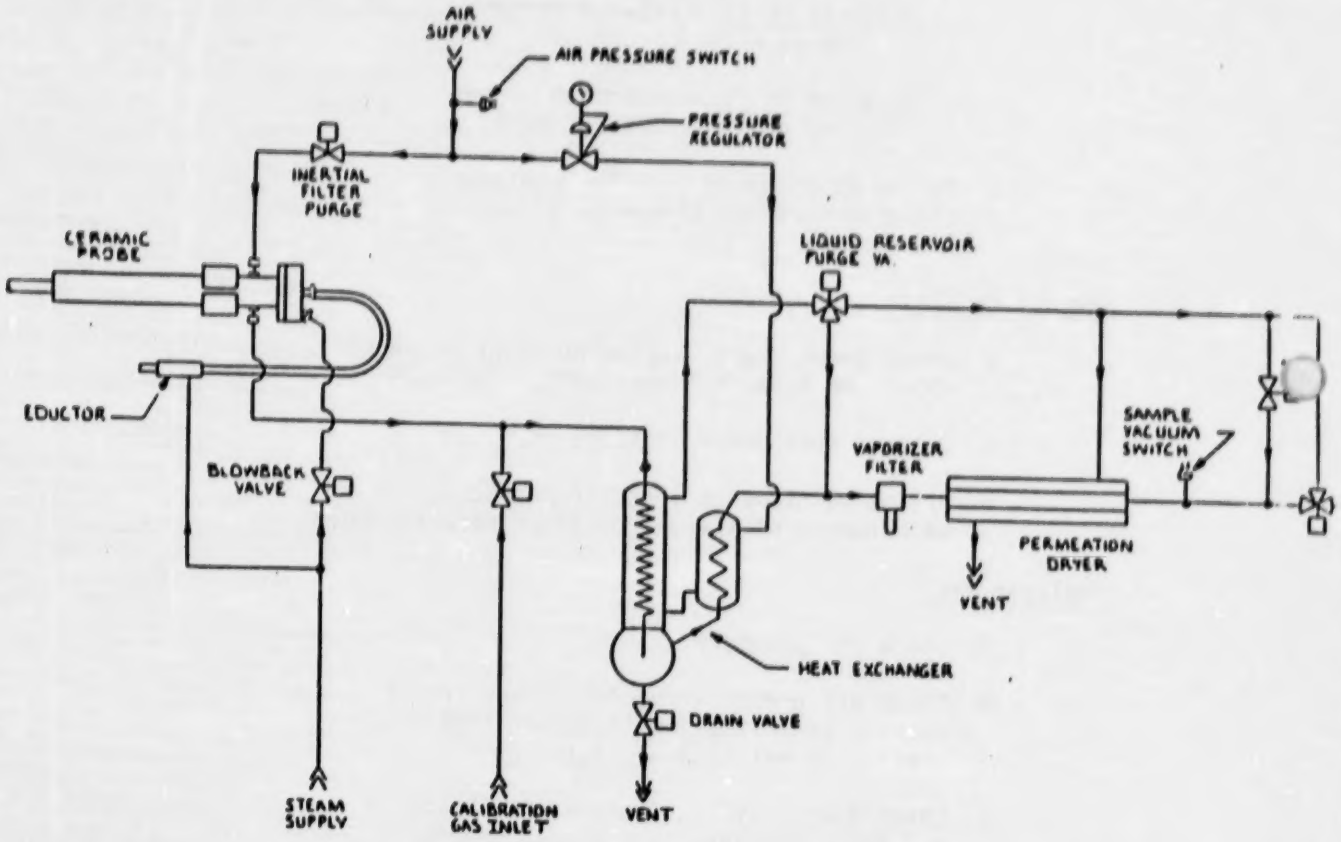
Switch Central Panel

- o Check to see all switches are in "auto" position. ____ ____
- o Observe if any red lights are lit indicating operating mode. ____ ____

Check Comment

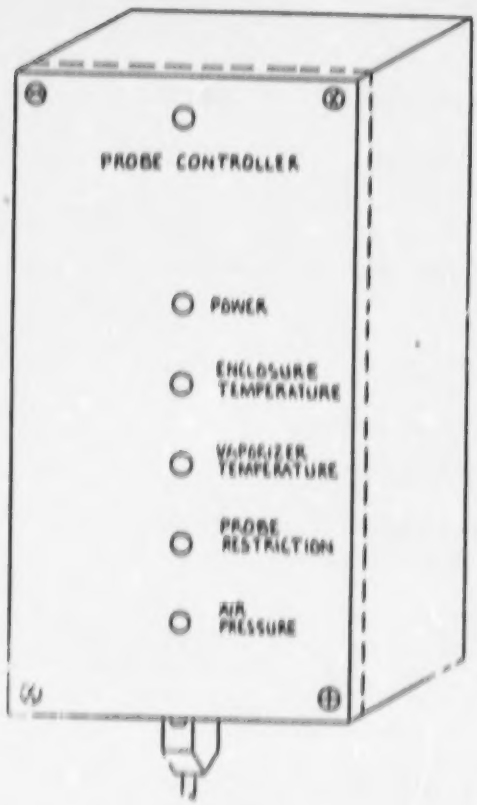
3.3.1.3 Probe/Conditioning System

The inspection of the probe/conditioning system involves both a review of the maintenance logs and a physical inspection of the unit itself. (Refer to the following diagram for inspection points). ____ _____



	Check	Commemt
o Observe overall condition of system.	_____	_____
Vibration Problems	_____	_____
Temperature Problems	_____	_____
Other_____	_____	_____
o Open cabinet and observe internal housekeeping.	_____	_____
Loose wires	_____	_____
Condenser dirty	_____	_____
Other_____	_____	_____
o Cal gas introduced at probe.	_____	_____
o Observe "back-purge" if applicable. Check drain for air/water.	_____	_____
o Observe automatic calibration cycle. (during automatic calibration cycle, the cal gas is under positive pressure to probe). If a leak in the system occurs, then the O_2 valve will never reach zero.	_____	_____
o Check "Fault Indicators" on probe controller box. Note. (Refer to following diagram for fault indicator location).	_____	_____

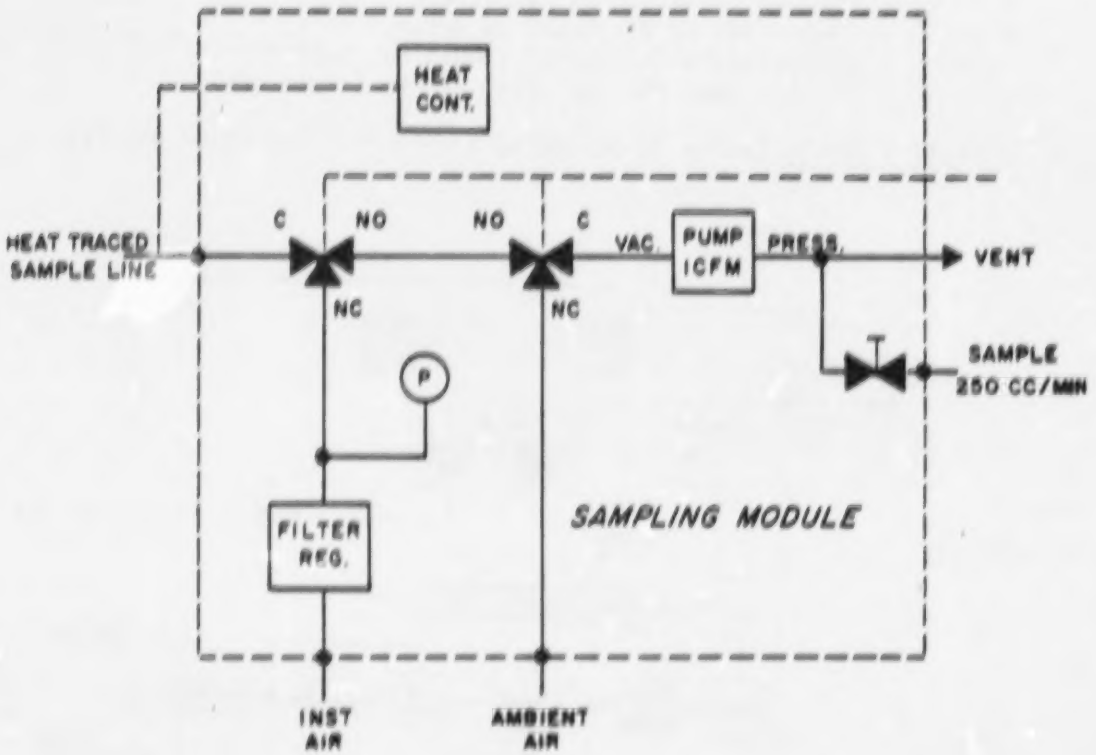
Indication	On/Off		
Power	_____	_____	_____
Enclosure Temperature	_____		
Vaporizer Temperature	_____		
Probe Restriction	_____		
Air Pressure	_____		



	Check	Comment
o Check water level in liquid resevoir, (should not be greater than one-fourth of bowl).	____	_____
o Check steam panel regulator (should be between 20-30 psi).	____	_____
o Check maintenance records for periodic maintenance on system.	____	_____
o Inertial filter changes		
Lime Kiln (2-4 weeks)	____	_____
Recovery Boiler (monthly)	____	_____
o Eductor removed/cleaned periodically	____	_____

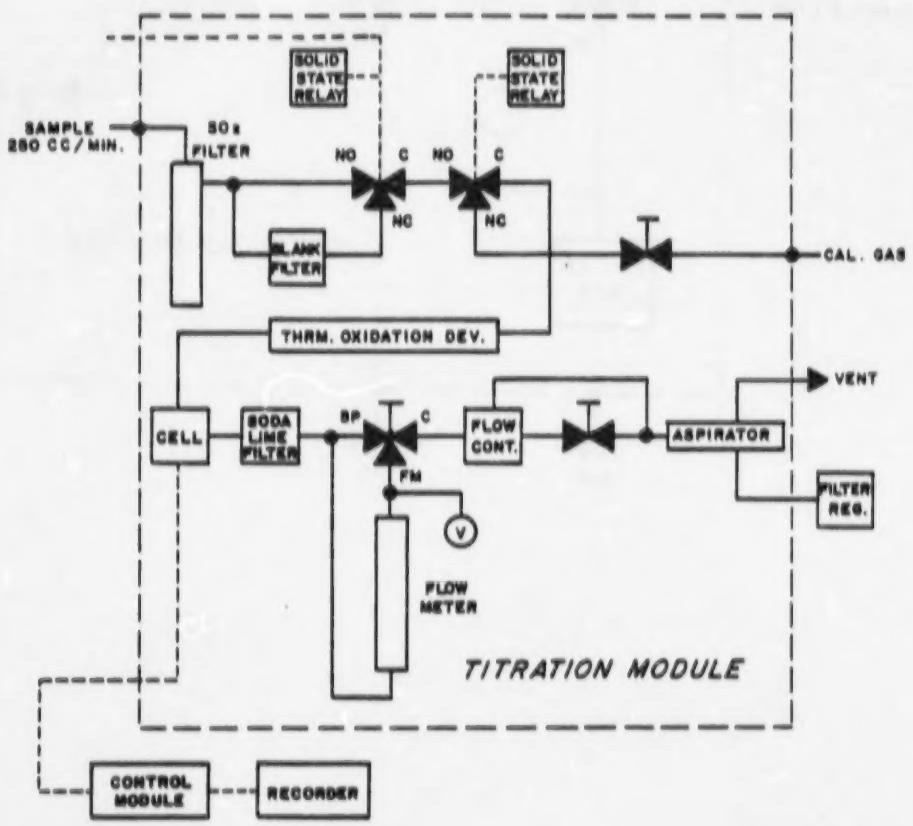
3.3.2 ITT BARTON TITRATION TRS CEM SYSTEM INSPECTION PROCEDURES

3.3.2.1 Sampling Module (Refer to following figure for inspection points).



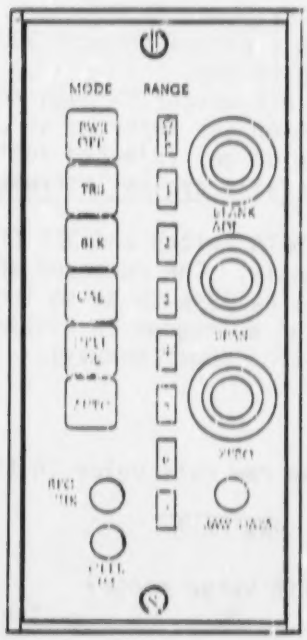
	Check	Comment
o Observe pressure of condensate resevoir regulator. 15 psi	____	_____
o Observe LED is lit on panel of heat trace line controller.	____	_____
o Observe "reading" of heat-trace line controller as displayed by meter. (Temperature indication should be 10-20°F higher than the dew point of the sample gas).	____	_____

Titration Module (Refer to following figure for inspection points).



	Check	Comment
o Insure the SO_2 scrubber solution is at the 500 ml mark.	____	_____
o Insure the titration cell reservoir is between stamped lines on cell.	____	_____
o Observe following setting of regulators.	____	_____
o Vortex tube supply _____ 80-120 psi		
o Aspirator Pressure _____ 35-50 psi		
o Purge pressure regulator _____ 5-10 psi		
o Check high volume pump operation by observing flow at pump vent point.	____	_____
o Verify heater operation by observing orange glow of the element through the observation point.	____	_____
o Observe flowmeter setting and compare to calibration sheet to insure sample flow of 250 cc/mm.	____	_____

Control Module (Refer to following figure for inspection points).



Check Comment

- Observe range switches. Note range monitor is on. ____ _____

  _____
  Range

- Note settings from zero/span/blank. Compare to historical data. ____ _____

  Zero _____ present _____ previous

  Span _____ present _____ previous

  Blank ADJ _____ present _____ previous

- Observe mode switches. Note which mode switch is illuminated. ____ _____

  _____
  Mode

The mode switches (TRS, BLK, CELL CAL and AUTO) determine the characteristics of the sample reaching the detector cell. The mode switch functions are listed in the following Table.

SWITCH	SAMPLE CHARACTERISTIC
PWR OFF	Instrument power ON/OFF.
TRS	Sample gas passes through SO_2 scrubber, remainder oxidized to SO_2.
BLK	Ambient air passes through the charcoal filter.
CAL	Calibration gas injected at probe.
CELL CAL	Calibration gas injected just before cell.
AUTO	Automatically cycles instrument through modes.

- Press RAW DATA switch and REC CHK switch simultaneously. The recorder should go to min-scale. (Failure to do so indicates the existence of a program in either the recorder or the control power supply). ____ _____

RAW DATA Function

- Measure the raw data value in the BLANK mode. ____ _____

  _____
  RAW DATA

- Is it within value range? ____ _____
  _____ No _____ Yes

Check Comment

- Measure the raw data values in either the TRS or CAL mode. ____ ____

  TRS/CAL value

- Subtract the lowest from the highest value. ____ ____
- Observe range switch setting. ____ ____
- From the following Table, obtain SO_2 conversion factor. ____ ____

Conversion Factor Data

RANGE SWITCH	SO_2 CONVERSION FACTOR	UNITY GAIN FULL SCALE	FULLSCALE RANGE	RAW DATA BLANK READING
1	0.035	3.5	1.0-5.0	20 ± 8
2	.82	8.2	5-15	12 ± 4
3	.26	26.	15-50	6 ± 3
4	.75	75.	50-150	3 ± 1.5
5	2.5	250.	150-500	2 ± .5
6	7.1	710.	500-1000	1.5 ± .8
7	23.	2300.	1000-3000	0.7 ± .4

- Calculate concentration by multiplying difference between sample and blank values by the SO_2 conversion factor. ____ ____

  ppm = (Sample Raw Data - Blank Raw Data) X Conversion Factor
  = (-) X ( )
  = _____

  Value determined should be within ± 15%.

- Press CELL CAL mode switch. ____ ____
- Note monitor response and compare to gas cylinder value. ____ ____

  Monitor Response Gas Cylinder Value

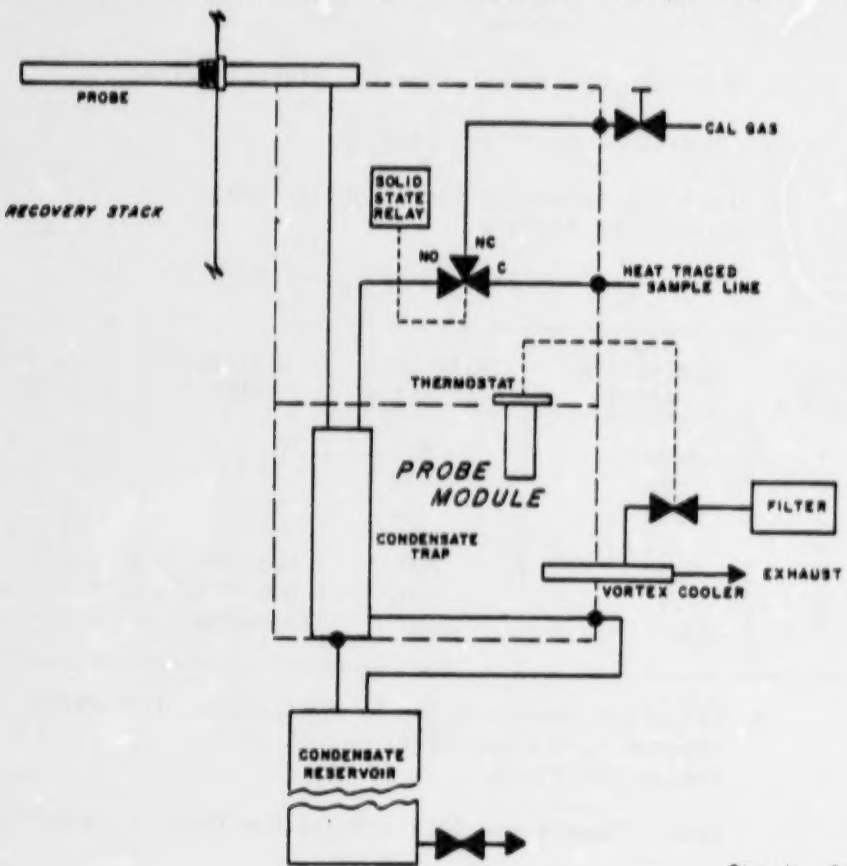
- Calculate % calibration error by the following equation.

$$\frac{\text{(Monitor Response) - (Gas Cylinder Response)}}{\text{(Gas Cylinder Response)}} \times 100$$

- Calculated value should be ± 15%.

3.3.2.2 Probe/Conditioning System

The inspection of the probe/conditioning system involves both a review of the maintenance logs and a physical inspection of the unit itself. (Refer to following diagram for inspection points).



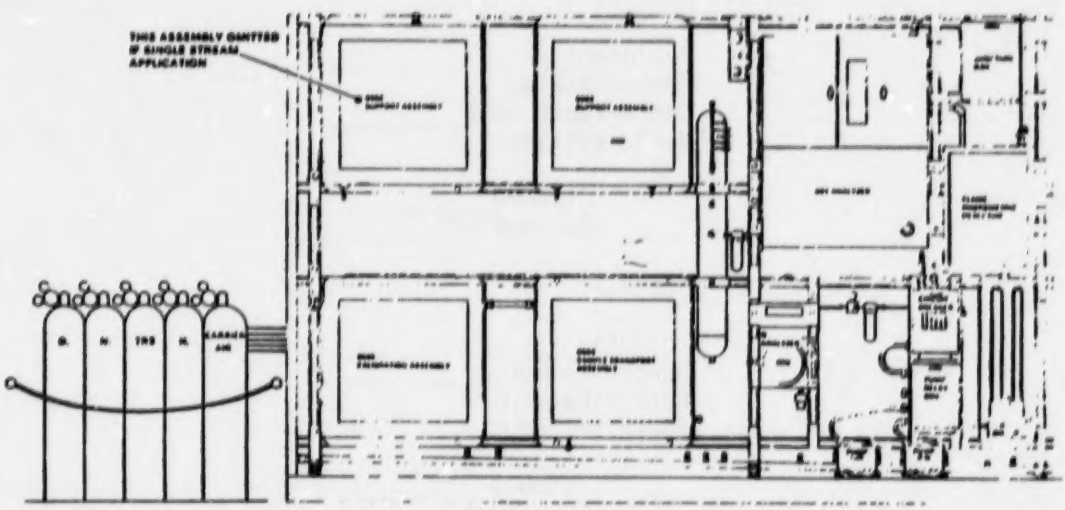
	Check	Comment
o Observe overall condition of system.	____	_____
Vibrational Problems _____		
Temperature Problems _____		
Other _____		
o Open cabinet and observe internal housekeeping.	____	_____

	Check	Comment
Loose wires _____		
Condenser trap dirty _____		
Other _____		
o Observe condensate reservoir, if possible Observe emptying of condensate trap during "blank" mode of operation.	____	_____
o During calibration mode, insure that calibration gas injection solenoid valve opens.	____	_____
o Is condensate trap frozen?	____	_____
o Observe that system back purges periodically.	____	_____
o Note whether sample line is heat traced.	____	_____

3.3.3 BENDIX TRS CEM SYSTEM INSPECTION PROCEDURES

3.3.3.1 Analyzer/Calibration Assemblies

The inspection of the above assemblies involves observing gauges/ flowmeters and comparing their indicated values to their "baseline" values. The observed values may change from week to week; but, reference should be made back to the "baseline" value. The following figure illustrates the assemblies we will be inspecting.



	Check	Comment

Calibration Gas Cylinder

- o Check certification of gas cylinders values and compare to maintenance logs and computer printout. ____ _____
- o Check cylinder numbers and compare to certification sheets. ____ _____
- o Observe primary/secondary pressure gauge and note setting. (Normal settings should be ~ 300 psi primary and ~ 40 psi secondary). ____ _____
- o Note following information on each gas cylinder. ____ _____

Gas Cylinder #1

Pollutant_____
Concentration_____
Certificate date_____
Gauge settings

Primary_____
Secondary_____

Gas Cylinder #2

Pollutant_____
Concentration_____
Certificate date_____
Gauge settings

Primary_____
Secondary_____

Gas Cylinder #3

Pollutant_____
Concentration_____
Certificate date_____
Gauge settings

Primary_____
Secondary_____

Gas Cylinder #4

Pollutant_____
Concentration_____
Certificate date_____
Gauge settings

Primary_____
Secondary_____

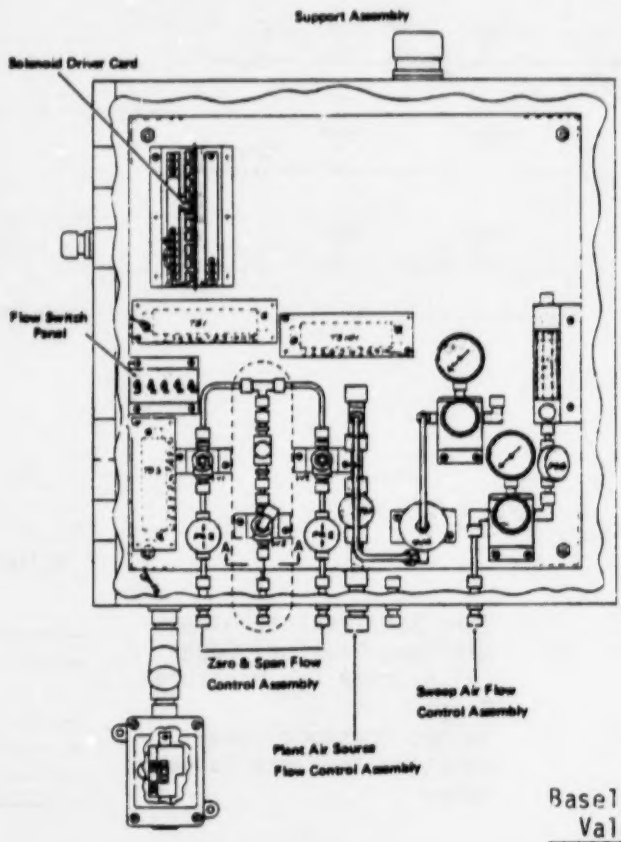
Gas Cylinder #5

Pollutant_____
Concentration_____
Certificate date_____
Gauge settings

Primary_____
Secondary_____

Support Assembly

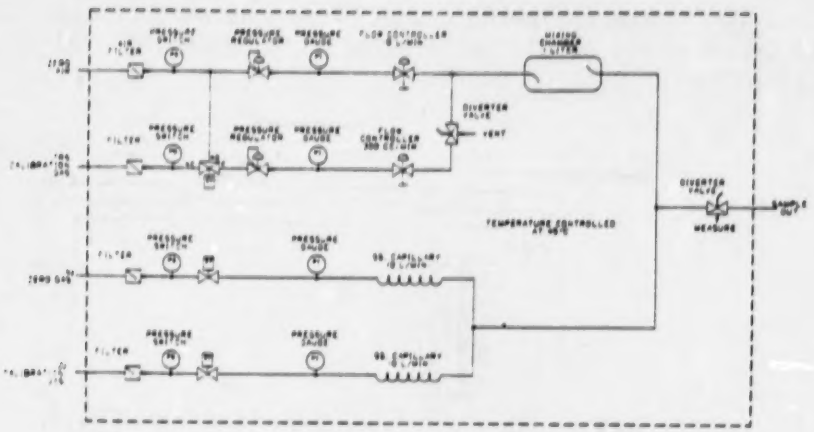
Observe the following gauges/meters as part of the Support Assembly. All observations should be referenced to "baseline" values. (Refer to diagram for inspection points).


Support Assembly
Solenoid Driver Card
Flow Switch Panel
Zero & Span Flow Control Assembly
Sweep Air Flow Control Assembly
Plant Air Source Flow Control Assembly

	Baseline Value	Observed Value
Sweep Air Flowmeter (A)	_____	_____
Sweep Air Pressure Gauge (B)	_____	_____
Plant Air Pressure Gauge (C)	_____	_____

Calibration Assembly

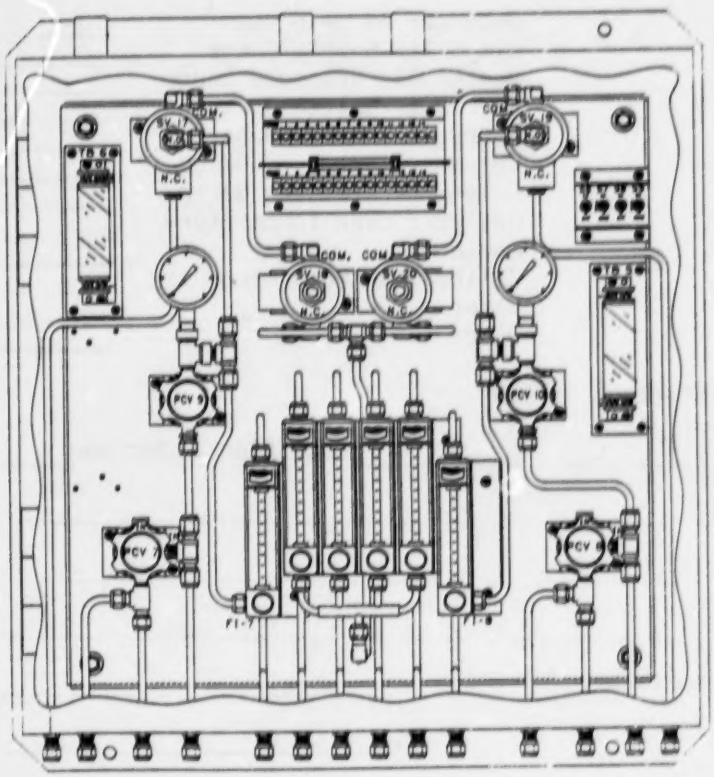
Observe the following gauges/meters as part of the Calibration Assembly. All observations should be referenced to "baseline" values. (Refer to diagram for inspection points).



	Baseline Value	Observed Value
Zero Air Pressure Gauge	_____	_____
Nitrogen Pressure Gauge	_____	_____
Calibration Gas Pressure Gauge	_____	_____
Oxygen Pressure Gauge	_____	_____
Dilution Pressure Gauge	_____	_____
Other	_____	_____

Sample Transport Assembly

Observe the following gauges/meters as part of the Sample Transport Assembly. All observations should be referenced to "baseline" values. (Refer to diagram for inspection points).



(Dual Gas Stream System Illustrated)

	Baseline Value	Observed Value
Oxygen Sample Flowmeter (D)	_____	_____
Gas Chromatograph Sample flowmeter (E)	_____	_____

Analyzer Controls and Indicators

Observe the following gauges/meters as part of the Analyzer Controls & Indicator Assembly. All observations should be referenced to "baseline" values.

	Baseline Value	Observed Value
Detector Purge Gauge		
Plant Air Supply Gauge		
Heater Air Pressure Gauge		
S/P Valve Switch On		
Hydrogen Supply Gauge		
Column #1 Pressure Gauge		
Column #2 Pressure Gauge		
Analyzer Oven Temperature Gauge		
Calibration Pump Gauge		
Other		
Other		

Gas Chromatograph System

Type: _____ Detection Technique: _____

Column 1: _____

2: _____

3: _____

Column Temperature (± 1°C) 1: _____

2: _____

3: _____

Sample Column Size: _____

Detection Temperature: _____

Attenuation: _____

Data Processor/Recorder

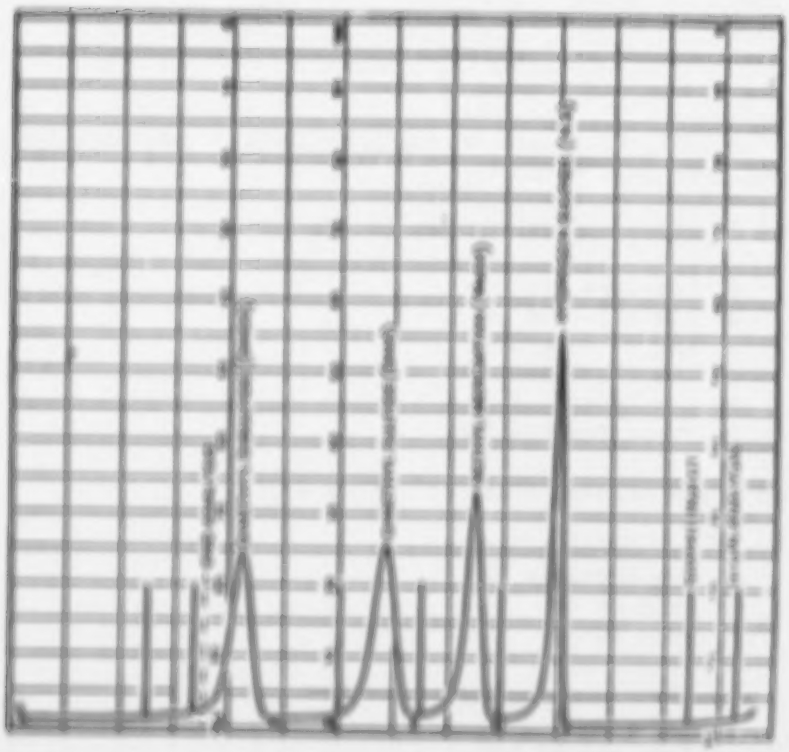
	Check	Comments
• Observe detections over previous day.		
◦ Consistent values? _____		
◦ Inconsistencies? _____		
◦ Problems? _____		
• Inspect previous zero/span calibration readings and compare to gas cylinder values.		

	Check	Comment
o Initiate an internal "zero/span" check of the monitor system. Compare to gas cylinder values.	_____	_____

	Cylinder Values	Monitor Response	% Calibration Error
H_2S	_____	_____	_____
CH_3SH	_____	_____	_____
$(CH_3)_2S$	_____	_____	_____
$(CH_3)_2S_2$	_____	_____	_____

(Are the calculated calibration errors < 20%?)

(A typical chromatograph of a zero/span check is illustrated below).



During the calibration, observe software report as recorded by the Data Printer. A "typical" printout follows:

	TRS COR (PPM)	TRS MEAS (PPM)	H2S (PPM)	CH3SH (PPM)	DMS (PPM)	DMDS (PPM)	O2 (%)	OPACITY (%)
STACK #1								
CALCINER (PLANT 2)								
	200.	190.	100.	33.00	33.00	34.00	10.1	10.6
STACK # 2								
LIME KILN (PLANT 2)								
	199.	189.	100.	32.00	33.00	34.00	10.1	21.7

GC CALIBRATION REPORT

DATE 1/21/79 0010:04

INJT 0001 STACK #1

CMPT	RF	OLD RF	NEW RF	(RF)%VAR	FC	% DRIFT
H2S	150	1.65	1.64	.6%	27	.5%
CH3SH	220	3.87	3.85	.5%	27	.7%
DMS	290	5.68	5.68	0%	27	.05%
DMDS	410	7.12	7.13	.01%	27	.1%

- Observe if any hardware/software alarms have been observed over the previous 24 hours.

Typical hardware alarms include the following:

- Low Zero Gas
- Low TRS Span Gas
- Low O2 Span Gas
- Low Plant Air
- Low Sweep Air
- Probe Restriction

Chromatograph related hardware alarms are:

- Low Carrier Gas
- Low Hydrogen
- Oven Hi
- Oven Lo
- Low Purge Air
- Flameout

Optional system alarms are:

- Low Sample Flow
- Low Sample Pump Vacuum

	Check	Comment

3.3.3.2 Probe/Conditioning Assembly

o Observe overall condition of system.	_____	_____
Vibration Problems	_____	_____
Temperature Problems	_____	_____
Other _____	_____	_____
o Open cabinet and observe internal housekeeping.	_____	_____
Loose wires_____	_____	_____
Condenser dirty_____	_____	_____
Other _____	_____	_____
o Cal gas introduced at probe?	_____	_____
o Observe "back-purge" if applicable. Check drain for air/water.	_____	_____
o Observe automatic calibration cycle, (during automatic calibration cycle, the cal gas is under positive pressure to probe. If a leak exists, then the O_2 valve will never reach zero during cal gas introduction.	_____	_____
o Listen for air flow to heat exchanger.	_____	_____
o Observe reading of Dew Point meter, if applicable.	_____	_____
o Go to opposite side of port and observe probe.	_____	_____

4.0 LEVEL IV CHECKLIST

4.1 Introduction

A Level IV evaluation involves a recertification of the installed CEM system utilizing Performance Specification Test 5 and 3. The role of the inspector during this level is to observe that proper sampling and computation of emissions from the source during testing occurs. At this time, additional "baselining" of the control equipment and continuous emission monitoring system can be performed.

To assist the inspector, observation checklists have been developed for both Federal Reference Method 16 and 16A. The inspector should use these checklists when performiong a Level IV evaluation.

Preceding page blank

Federal Reference Method 16
Observation Checklist

Page___of___

_____
Initial

Federal Reference Method 16
Observation Checklist

1.0 BACKGROUND INFORMATION

1.1 Source Name:_____

1.2 Location: _____

1.3 Affected Facility:_____

1.4 Test Dates:_____

1.5 Test Team:_____

Leader:_____

Members:_____

1.6 Plant Contact:_____

1.7 Corporate Contact:_____

Phone #_____

Title_____

2.0 PROCESS DATA

2.1 Process Tested:_____

2.2 Process Description:_____

_____

2.3 Process Operating Data:_____

_____

3.0 TEST EQUIPMENT

3.1 Sketch system used for sampling and analysis (including calibration system).

_____
Initial

3.2 - TEST EQUIPMENT DESCRIPTION

3.2.1 Probe/SO_2 Scrubber System

3.2.1 Probe

Length:_____ID:_____

Material of Construction:_____

Filter Device: Out-of-stack_____

In-Stack_____

Material_____

Heated?_____

3.2.1.2 SO_2 Scrubber

Impinger Technique:_____

Solution:_____

pH of Solution:_____

3.2.2 Sample Lines/Pump

3.2.2.1 Lines:

I.D.:_____O.D.:_____

Material of Construction:_____

Heated? _____

3.2.2.2 Pump

Type:_____

Material of Construction:_____

Heated:_____

3.2.3 - Dilution System

Technique:_____

Dilution Ratio: 1._____ 2._____ 3.____

Dilution Gas:_____

Heated?_____

Initial

3.2.4 - Gas Chromatograph System

Type:_____ Detection Technique:_____

Column 1. _____

2. _____

Column Temperature (± 1°C) 1._____

2._____

3._____

Sample Column Size:_____

Detection Temperature:_____

Attenuation:_____

Gas Flow:

H_2 Flow:_____

Air Flow:_____

N_2 Flow_____

Accuracy Range:_____

Detect 0.5 ppm for H_2S, MeSH, DMS and DMDS?_____

_____

3.2.5 - Calibration System

3.2.5.1 - Permeation Technique

Pollutant	Certification Number	Permeation Rate	Certification Temperature	Traceability Technique
H_2S				
MeSH				
DMS				
DMDS				

Analysis Date	Vendor

H_2S = Hydrogen Sulfide; MeSH = Methyl Mercaptan; DMS = Dimethyl Sulfide; DMDS = Dimethyl Disulfide

Page___ of___

_____
Initial

Remarks:_____

_____

_____

Constant Temperature Bath (± 1°C) of Permeation Tube Certification Sheet_____

Flowmeter Calibrated?_____

Date_____

Calibration Curve_____

Flow of Calibration System greater than demand of Analytical System?_____

Bubble Meter used to monitor flow?_____

Temperature indicator calibrated?_____

Carrier gas prepurified?_____

_____

Discuss_____

_____

Diluent Gas - 50ppb S compounds?_____

10ppm each of H_2O and HC:_____

Heated prior to mixing?_____

3.2.5.2 - Cylinder Gases

Pollutant (in Air)	Concentration	Traceability to NBS Permeation tube	Analysis Date	Expiration Date
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

Remarks_____

_____

_____
Initial

Greater than 200 psi in gas cylinders?_____

Vent valve utilized?_____

3.2.6 - Integrator or Recorder

Type:_____

Averaging Time:_____

Attenuation:_____

Last calibration:_____

4.0 - SAMPLE PORT LOCATION

Stack/Duct Conditions (leaks, particle build-up, corrosion):

_____

_____

Number of stack diameters upstream from flow disturbance:_____

Number of stack diameters downstream from flow disturbance:_____

Velocity Traverses Performed:_____

Number of points_____

Location_____

Avg. Δp_____

Pitot tube calibration factor_____

Date Calibrated_____

Avg. Velocity_____

Stack Temperature Sensor:

Type:_____ Range:_____

Location in Stack:_____

Date Calibrated:_____ Calibration Papers Rec'd_____

Remarks:_____

_____

_____

_____
Initial

Location of CEM in reference to Sample Port Location:_____

_____

5.0 PRE-TEST ACTIVITIES

System set-up properly?_____

System leak check (optional)_____

2 inches Hg Vacuum for 1 minute_____

Pass_____ Failed _____

All components operating properly_____

Discussion:_____

_____

_____

Pre-Test Recovery Determined (optional)_____

Discussion:_____

_____

_____

5.1 Interference Determination

Chromatograph submitted of calibration gases with/without 10% CO_2?_____

Agreement within 5%_____

Chromatograph submitted showing separation of SO_2 from other peaks?_____

or

SO_2 Scrubber System used to remove SO_2 prior to GC analysis

_____

Initial

Chromatograph submitted showing resolution of Sulfur Dioxide (SO_2), Hydrogen Sulfide (H_2S), Methyl Mercaptan (MeSH), Dimethyl Sulfide (DMS) and Dimethyl Disulfide (DMDS):_____

_____

_____

Discussion:_____

_____

_____

5.2 Calibration of GC/FPD and Dilution System

5.2.1 GC/FPD Calibration through SO_2 Scrubber Dilution System prior to calibration?_____

Permeation tubes in bath 24 hours?_____

Calibration Curve developed from three injections of three known concentrations of H_2S, MeSH, DMS, and DMDS?_____

Calibration Curve developed in range data is being collected?

_____

Precisions of injections for each known TRS within $\pm$ 5% of mean value?_____

Temperature of bath $\pm$ 0.1°C of certification tube temperature_____

Calibration Curve Generated?_____

5.2.2 Dilution System

Injection of H_2S in front of Dilution System?_____

Three injections?_____

Precision of three injections $\pm$ 5% of mean value?_____

Dilution factor calibrated for each stage?_____

Stage 1 Factor _____

Stage 2 Factor _____

6.0 STACK TEST

Port closed around probe?_____

_____
Initial

Sample traversed at three points in source (16.7, 50.0 and 83.3%) of stack diameter?_____

Sampling System conditioned 15 minutes prior to test?_____

Sample run consists of a min. of 16 individual injections performed over a period of not less than 3 hours or more than 6 hours?_____

_____

Discussion:_____

_____

_____

Orsat collected during sample run?_____

_____

Orsat collection technique and location_____

GAS CHROMATOGRAPH INFORMATION

	Run 1	Run 2	Run 3
Date	_____	_____	_____
Time Began	_____	_____	_____
Time End	_____	_____	_____
No. of Injections or Analysis (min 16)	_____	_____	_____
Ave H_2S conc, ppm	_____	_____	_____
Ave MeSH Conc, ppm	_____	_____	_____
Ave DMS conc, ppm	_____	_____	_____
Ave DMDS Conc, ppm	_____	_____	_____
Ave TRS Conc, ppm as SO_2	_____	_____	_____
Concentration of trace gas	_____	_____	_____
Ave O_2 Conc, %	_____	_____	_____

Initial

7.0 - POST TEST PROCEDURES

7.1 - Sample Line Loss - Correction Factor Known concentration of H_2S injected as close to probe tip as possible?_____

_____

_____

Concentration of H_2S generated at level of standard (± 20%)?____

_____

_____

H_2S Generated By:

Permeation System_____

Cylinder Gas Dilution_____

% Recovery

20%_____(Sample run not to be used)

20%_____(Sample run corrected)

Recovery Correction Factor_____

_____

7.2 - Recalibration of SEAM and Dilution System

7.2.1 - SEAM

Known concentration of H_2S injected into SEAM?_____

Compared to original calibration curve?_____

_____

Calibration Drift ± 10%?_____

_____

Highest sample values chosen if calibration drift 10%_____

Discussion:_____

_____

_____

Page___of___

_____
Initial

7.2.2 - Dilution System

Known concentration of H_2S injected into front of Dilution System?_____

Compared to original calibration curve?_____

_____

Calibration Drift ± 10%?_____

_____

7.3 - LEAK CHECK

Sampling system leak checked?_____

Technique?_____

8.0 - CALCULATIONS

Individual concentrations of H_2S, DMS, DMDS and MESH Recorded? (Oxygen Corrected)

	Run 1 (avg. ppm)	Run 2 (avg. ppm)	Run 3 (avg. ppm)
H_2S	_____	_____	_____
MeSH	_____	_____	_____
DMS	_____	_____	_____
DMDS	_____	_____	_____
Total	_____	_____	_____

Initial

9.0 - RELATIVE ACCURACY

9.1 Calculation

	TRS (ppm)		
	Run 1	Run 2	Run 3
Reference Method			
TRS Conc. ($\%O_2$ corrected)			
CEM TRS Conc.			
($\%O_2$ Corrected)			
Difference			
Avg. Differences			

9.2 % Relative Accuracy = $\frac{|\text{avg}| + \text{C.I.}_{95\%}}{[\text{RM avg}]} \times 100$

= _____ (_ 20%)

10.0 - SUMMARY

Are final results expressed in units which satisfy permit or Agency requirements?_____

_____

Does tester have documentation to support emission calculations (only required on smelt dissolving tank vents)?_____

_____

Page___of____

_____
Initial

Brief Summary of Test:_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

11.0 - AUTHORIZATION

11.1 - Regulatory Observer

Observer Signature_____

Title_____

Organization_____

Address_____

_____

Telephone #_(____)_____

11.2 - Company Observer

Company Observer Signature_____

Title_____

Telephone #_____

TOTAL REDUCED SULFUR
FIELD CALIBRATION DATA SHEET
FEDERAL REFERENCE METHOD 16

Company _____ Date _____

Address _____ Analyst _____

_____ Sampling Location _____

_____ _____

Company Contact _____

I. Permeation Tube Information

Information	Pollutant			
	H_2S	CH_3SH	$(CH_3)_2S$	$(CH_3)_2S_2$
Tube I. D. #:				
Permeation Rate (PR)				

II. Calibration Curve

Point #1

Time _____
Flow (Q) _____
Known Concentration (ppm)
H_2S: _____
CH_3SH: _____
$(CH_3)_2S$: _____
$(CH_3)_2S_2$: _____

	Area			
1				
2				
3				
Avg.				

Point #2

Time _____
Flow (Q) _____
Known Concentration (ppm)
H_2S: _____
CH_3SH: _____
$(CH_3)_2S$: _____
$(CH_3)_2S_2$: _____

	Area			
1				
2				
3				
Avg.				

Point #3 | Pollutant Area

Point #3

Time _____
Flow (Q) _____
Known Concentration (ppm)
H_2S: _____
CH_3SH: _____
$(CH_3)_2S$: _____
$(CH_3)_2S_2$): _____

	Pollutant Area			
	H_2S	CH_3SH	$(CH_3)_2S$	$(CH_3)_2S_2$
1				
2				
3				
Avg.				

III. Equation

$$c = \frac{(PR)\left(\frac{24.46\,\mu\ell/\mu\text{-mole}}{(M)\ \mu g/\mu\text{-mole}}\right)\left(\frac{T°K}{298°K}\right)\left(\frac{760\text{ mm Hg}}{P\text{ mm Hg}}\right)}{Q\ \ell/\text{min}}$$

Where: c = *concentration,* $\mu\ell/\ell$ *or ppm by volume*
T = *temperature of the system,* °K
P = *pressure of the system, mm Hg*
PR = *permeation rate,* $\mu g/min$
Q = *total flow rate, liters/min*
M = *molecular weight of the permeating gas,* $\mu g/\mu$-*mole*
24.46 = *molar volume* ($\bar{V}$) *of any gas at* 25 °C & 760 *mm Hg,* $\mu\ell/\mu$-*mole*

c = _____

IV. Remarks: _____

_____

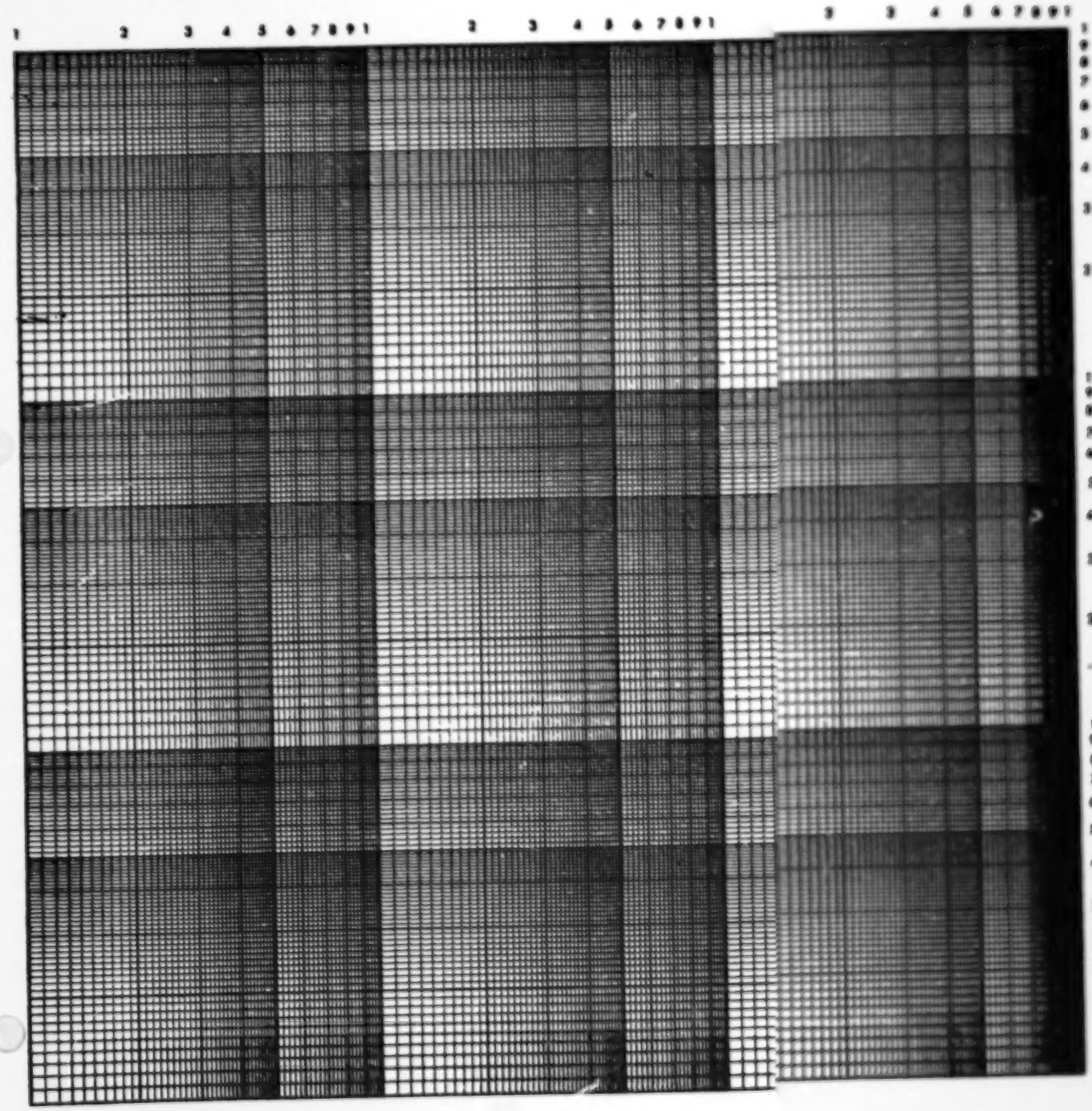
_____

_____

_____

V. Graph Calibration Curve

Using the graph paper below, graph either the peak area, peak height or available integrator information for each of the individual sulfur standards vs. concentration. Draw the best fit line through the plotted points and determine source sample concentration from the established calibration curve.



TOTAL REDUCED SULFUR
FIELD RELATIVE ACCURACY DATA SHEET
FEDERAL REFERENCE METHOD 16

Company _____ Date _____

Address _____ Analyst _____

_____ Sample Location _____

_____ _____

Company Contact _____

I. Field Data

		Total Reduced Sulfur (TRS) Concentration, ppm		
Run #	Time	CEM Concentration, ppm (O_2 corrected)	Reference Method, ppm (O_2 corrected)	Difference (ppm)
1				
2				
3				
4				
5				
6				
7				
8				
9				
Avg.				

II. Calculation

$$\% \text{ Relative Accuracy} = \frac{|\bar{x}| + \text{C.I } 95\%}{[RM_{avg}]} \times 100$$

$$= \frac{\quad + \quad}{\quad} \times 100$$

$$= \_\_\_\_\_$$

III. Acceptance

Performance Specification 5 (PS5) states for a TRS monitor to be acceptable its relative accuracy "shall be no greater than 20 percent of the mean value of the reference method (RM) test data in terms of the units of the emission standard or 10 percent of the applicable standard, whichever is greater."

IV. Recovery Data

% Recovery $\geq 20\%$ _____ Yes _____ No

Preceding page blank

Federal Reference Method 16A
Observation Checklist

Initial

Federal Reference Method 16
Observation Checklist

1.0 BACKGROUND INFORMATION

1.1 Source Name:_____

1.2 Location: _____

1.3 Affected Facility:_____

1.4 Test Dates:_____

1.5 Test Team:_____

Leader:_____

Members:_____

1.6 Plant Contact:_____

1.7 Corporate Contact:_____

Phone #_____

Title_____

2.0 PROCESS DATA

2.1 Process Tested:_____

2.2 Process Description:_____

_____

2.3 Process Operating Data:_____

_____

3.0 TEST EQUIPMENT

3.1 Sketch system used for sampling and analysis (including calibration system).

Initial

4.0 SAMPLE PORT LOCATION

4.1 Stack/Duct Conditions (leaks, particle build-up, corrosion):

_____

_____

4.2 Number of stack diameters upstream from flow disturbance:____

4.3 Number of stack diameters downstream from flow disturbance:__

4.4 Velocity Traverses Performed:_____

Number of points_____

Location_____

Avg. Δp_____

Pitot tube calibration factor_____

Date Calibrated_____

Avg. Velocity_____

4.5 Stack Temperature Sensor:

Type:_____ Range:_____

Location in Stack:_____

Date Calibrated:_____ Calibration Papers Rec'd_____

4.6 Remarks:_____

_____

_____

4.7 Location of CEM in reference to sample port location_____

_____

_____

5 5.0 SAMPLE TRAIN PREPARATION

5.1 - Probe

Material of Construction_____

Heated?_____ Temperature_____

5.2 - SO_2 Scrubber System

Type_____

Citrate Acid Buffer Added?_____

Initial

pH of Solution_____

Location of Probe?_____

_____

5.3 - Oxidizing Furnace

Type_____

Material of Construction_____

Tube Dimensions_____

Temperature_____

5.4 - SO_2 Impinger Train

Type_____

Hydrogen Peroxide added to Impingers ?_____

Quantity_____

Glass Wool plug used?_____

_____

5.5 - Dry Gas Meter

Type_____

Volume_____

Correction Factor_____

Date Calibrated_____

Calibration Papers Revised?_____

Temperature Measured?_____

6.0 PRE-TEST ACTIVITIES

6.1 - Pre-test leak check (optional)

6.1.1 Complete sampling train checked:_____

_____

6.1.2 Vacuum of 10 inches mercury?_____

Page___of___

Initial

6.1.3 Leak rate 40 cc/min?_____

_____

6.1.4 Pump leak checked?_____

_____

6.2 - System Performance Check

6.2.1 Sketch sampling train and gas dilution system.

6.2.2 List gases available, concentration, traceability, analysis date, expiration date and gas cylinder pressure (include information in both calibration gas and dilvent gas).

Initial

Pollutant	Concentration	Traceability	Analysis Date	Expiration Date	Cylinder Pressure

6.2.2.1 Dilvent gases contain 50 ppb total sulphur compound and 10ppm

6.2.2.2 Total HC?

6.2.2.3 Calibration gases verified by Reference Method 11, GC/FPD or zinc acetate technique

6.2.2.4 Rotometers used in dilution system calibrated?

6.2.2.5 Dry gas meter used in Dilution System calibrated?

6.2.2.6 Flows measures by bubble meter?

6.2.2.7 Concentrations generated?

6.2.3 System Performance Check Form

6.2.3.1 Two thirty minute samples taken?

Date				
Run I.D.				
Time Began				
Time Ended				
Dry Gas Meter Volume				

Page ___ of ___

[illegible]

[illegible] (as 1)				
[illegible] [illegible] (as 1)				
[illegible] (as 1)				
[illegible]				
[illegible]				
[illegible]				

(i) (ii) (iii) [illegible]

(i) (ii) (iii) [illegible]

(i) (ii) (iii) [illegible]

7.0 [illegible]

7.1 General

7.1.1 Last check performed after cycle performance check? ___

7.1.2 Sample extraction involving either: (1) three ore four samples at 37 liters/min? ___

(2) Has three four sample of 120 liters take vicinity or centroid? ___

7.1.3 Sampling location sequencing check? ___

7.1.4 Sampling furnace optimized at 800°C? ___

7.1.5 Strobe buffer solution obtained? ___

[illegible] The strobe buffer solution solves the change 22°C, sampling set to vicinity check from sample strobe set go from this.)

7.2 Fields Has Required

Has				
Has 7.0				
Has Days				
Has Hold				
Has Strobe Vicinity				
Has Ha Ha Has				
Ha Ha Has Strobe [illegible]				

7.2.1 Sampling Has performed 5.0 thermometers (C 45)

7.2.2 Has this has has been performed? ___

Initial

F.2.c.3 Impingers containing hydrogen peroxide recovered? _____

- sample recovery bottle labeled? _____

- fluid level indicated on side of bottle? _____

F.2.c.4 Probe/Sample line to SO_2 scrubbers rinsed after each run?

_____

8.0 - SAMPLE RECOVERY TEST

8.1 - General

8.1.1 Was a leak test performed prior to the sample recovery test? _____

8.1.2 Were SO_2 impingers re-charged with hydrogen peroxide?

_____

List gases available, concentration, traceability, analysis date, expiration date, date and gas cylinder pressure (include information in both calibration gas and dilution gas):

Pollutant	Concentration	Traceability	Analysis Date	Expiration Date	Cylinder Pressure

8.1.3 Dilution gases contain $\leq$ 1% ppm total sulfur compound?

_____

8.1.4 Calibration gases verified by Reference Method (i.e. EB/EPA or this section) technique? _____

8.1.5 Rotameters in dilution system calibrated? _____

_____

_____

8.1.6 Dry gas meter in dilution system calibrated? _____

_____

_____

8.1.7 Flows measured by bubble meter? _____

_____

8.2 Sample Recovery Test Field Data

Date				
Run I.D.				
Time Began				
Time Ended				
Dry Gas Meter Volume(ft^3)				

9.0 - ANALYSIS

9.1 Source Sample

Run Number				
Dry Gas Meter Volume (ft^3)				
Volume of Solution (ml)				
Volume of Solution Titrated (ml)				
Volume of Sample Titrant (ml)				
Normality of Titrant				
Volume of Blank Titrant				

9.2 Sample Train Recovery

Run Number				
Dry Gas Meter Volume (ft^3)				
Volume of Solution (ml)				
Volume of Solution Titrated (ml)				
Volume of Sample Titrant (ml)				
Normality of Blank Titrant				
Volume of Blank Titrant				

_____
Initial

10.0 CALCULATIONS

10.1 Calculate the volume of gas sampled corrected to standard conditions, for each sample run utilizing the following equation (for Sample and Sample Train Recovery):

$$V_{m(std)} = 17.64\ (Y)\ \left(\frac{V_m P_{bar}}{T_m}\right)$$

Where: $V_{m(std)}$ = volume of gas sample through the dry gas meter at standard conditions, dscf

V_m = volume of gas sampled through the dry gas meter, (cu.ft.)

T_m = average dry gas meter temperature, (°R)(°F + 460)

17.64 = conversion factor $\left(\frac{°R}{\text{in. Hg}}\right)$

$$= \frac{528°R}{29.92\ \text{in. Hg}}$$

Y = dry gas meter calibration factor, dimensionless. For our source test, we will assume a dry gas meter calibration factor of Y = 1.

P_{bar} = barometric pressure, in. Hg

$$V_{m(std)} = (17.64)(1)\left[\frac{(\quad\quad)(\quad\quad)}{(\quad\quad)}\right]$$

$$= \quad\quad\quad\quad \text{dscf.}$$

Initial

10.2 Calculate concentration (ppm) of both source sample and Sample Train Recovery utilizing the following equation:

$$c_{SO_2} = K_2 \frac{N(V_t - V_{tb}) \left(\frac{V_{soln}}{V_a}\right)}{V_{m(std)}}$$

Where: c_{SO_2} = emission rate of sulfur dioxide, ppm
V_t = volume of titrant required for sample (mL), $Ba(ClO_4)_2$
V_{tb} = volume of titrant required for blank (mL), $Ba(ClO_4)_2$
N = normality of $Ba(ClO_4)_2$ (meq/mL)
V_{soln} = total volume of sample (mL)
$V_{m(std)}$ = volume of sample corrected to standard conditions (dscf)
V_a = volume of aliquot titrated (mL)
K_2 = 424.30

$$c_{SO_2} = \left[424.30\right] \left[\frac{(\quad)(\quad - \quad)\left(\frac{\quad}{\quad}\right)}{(\quad)}\right]$$

= _____

Initial

10.0 - SUMMARY

Are final results expressed in units which satisfy p permit on agency requirements?_____ _____

_____ _____

Does Tester have documentation to support emission c calibrations (only required on smelt dissolving tank vents)?____ _____

_____ _____

Brief Summary of Test_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

_____ _____

11.0 - AUTHORIZATION

11.1 Regulatory Observer

Observer Signature_____ _____

Title_____ _____

Organization_____ _____

Address_____ _____

_____ _____

11.2 Company Observer_____ _____

Company Observer Signature_____ _____

Title_____ _____

Telephone #_____ _____

FIELD INSPECTION NOTEBOOK
TOTAL REDUCED SULFUR
CONTINUOUS EMISSION MONITORING SYSTEM
ABBREVIATED INSPECTION PROCEDURES

FIELD INSPECTION NOTEBOOK
TOTALS REDUCED SULFUR
CONTINUOUS EMISSION MONITORING SYSTEM
ABBREVIATED INSPECTION PROCEDURES

Once a thorough evaluation of the TRS CEM system has been accomplished, control agency personnel may want to perform the next inspection on a less comprehensive basis. To assist the control agency personnel, an abbreviated inspection procedure checklist has been developed. The abbreviated checklist is applicable to all TRS CEM systems. It does not address monitor specific inspection points, but does evaluate the TRS monitor on a system audit basis. The checklist is divided into three major areas:

- o Control agency records review;
- o Control agency records update; and
- o Source TRS CEM system review.

The control agency records review consists of a review of permits and/or any current enforcement actions to determine the purpose of the CEM. In addition, a review of the PST report and current EER is conducted to verify conformance with the appropriate performance specification and reporting requirements for EERs.

The control agency records update is conducted by telephone to verify that the records in agency files correctly describe the current CEM status.

Finally, the source TRS CEM system review evaluates a source's record-keeping, data reduction procedures, monitor evaluation through zero/span checks and overall system review.

Preceding page blank

ABBREVIATED INSPECTION PROCEDURES
TOTAL REDUCED SULFUR CONTINUOUS EMISSION MONITORING SYSTEM
CONTROL AGENCY RECORD REVIEW

SOURCE NAME _____
SOURCE ADDRESS _____
SOURCE CONTACT _____
SOURCE TELEPHONE NO. _____
DATE _____

ACTION REQUIRED*

1 - PERMIT REVIEW

____ Is CEM required by permit? Yes___ No___
____ CEM requirement due to: NSPS ___
____ SIP ___
____ Enforcement Action ___

____ Is CEM installed? Yes___ No___
____ CEM Installation/startup date ____/____
____ Allowable emission rate _____
____ Date of source performance test _____

2 - CEM PERFORMANCE SPECIFICATION TEST (PST) REPORT REVIEW

____ Dates of PST (<30 days after performance test) _____
____ Date PST report submitted (<60 days after OTP[1]) _____
____ Date of process startup (<180 days prior to OTP) _____
____ Date of initial full-load operation (<60 days prior to OTP) _____
____ Emission Rate Conversion formula _____

CEM SUMMARY

	OPACITY	TRS	O_2
Analyzer			
Manufacturer			
Model			
Serial			
Recorder			
Manufacturer			
Model			
Serial			
Type[2]			

PST REPORT REVIEW

	OPACITY	TRS	O_2
Relative Accuracy			
Calibration Error			
Response Time			
24 Hr. Span Drift			
24 Hr. Zero Drift			

1 OTP= Operational Test Period
2 Magnetic Tape, Strip Chart, Data Logger, Other (describe).

Preceding page blank

CALIBRATION REFERENCE MATERIAL REVIEW

	OPACITY	NO_x	O_2
F	Full Span Value		
U	Upscale Value		
M	Mid Span Value		
C	Calibration Value		
G	Gas Value Verification		
	EPA Triplicate Analysis/Date		
	NBS Traceable (Protocol 1)		
	Other		
G	Gas Cell Value Verification		
	Manufacturer/Date		
	Comparison to Gas/Date		
	Agency Verification		
	Other		

ACTION REQUIRED

M Was stratification evaluated? _____ Discuss _____

D Describe monitor locations (diluent and pollutant) _____

3 - EXCESS EMISSION REPORT REVIEW

Months reported _____

Did each excess emission report document:

	Date, time, and duration of excess emissions	Yes ___	No ___
	Magnitude of excess emissions	Yes ___	No ___
	Reason for excess emissions	Yes ___	No ___
	Corrective action taken to reduce emissions	Yes ___	No ___
C	Conversions factor/formula _____	Yes ___	No ___
C			
	Method for determing conversion or correction factors used in calculating emission rate.		
M	Moisture content _____		
	Gas velocity _____		
	Temperatue _____		
	Diluent gas concentration (O_2) _____		
	Corrective action taken to reduce emissions	Yes ___	No ___
	Briefly discuss corrective action _____		
	Process downtime	Yes ___	No ___
	Monitor downtime	Yes ___	No ___
	Corrective action taken to return monitor to operation	Yes ___	No ___
	Briefly discuss corrective action _____		

What percent availability did the CEM system achieve? _____

(2190 - # hrs. downtime) /2190 = % availability

CONTROL AGENCY RECORDS UPDATE

FIELD REVIEW _____
TELEPHONE REVIEW _____
DATE _____

ACTION REQUIRED

1 - SYSTEM OPERATION & MAINTENANCE

Is monitoring system currently operational? Yes ___ No ___

_____ Is system calibration checked daily? ___ Automatic
_____ ___ Manual

Are recommended maintenance schedules/procedures provided by the CEM manufacturer and followed? Yes ___ No ___

_____ What group or person is responsible for CEM maintenance? _____

Is manufacturer's recommended spare parts list in plant inventory; or on order? Yes ___ No ___

_____ Are CEM system malfunctions documented to identify recurring failures of components or subsystems? Yes ___ No ___

2 - RECORDKEEPING AND DATA REDUCTION TECHNIQUES

What are the engineering units of the data recorded by the CEM system?
What data reduction procedure is used in calculating emission rates?

Over what time intervals are data averaged? _____
Are chart speed, span value, date and time documented? Yes ___ No ___
Where is this data filed? On site _____
Home office _____
Other _____

Is the following information filed for the previous two years:

_____ All system calibrations Yes ___ No ___
_____ All maintenance performed on the CEM system Yes ___ No ___
_____ All CEM system outages Yes ___ No ___
_____ Span gas certified Yes ___ No ___
_____ Triplicate reference method analysis of span gas Yes ___ No ___
_____ PST reports Yes ___ No ___
_____ Modifications to the CEM system Yes ___ No ___
_____ Excess Emission Reports Yes ___ No ___
_____ Performance Test Reports

Does span gas value (gas cell or neutral density filter) correspond to appropriate subpart requirements? Yes ___ No ___

_____ Are zero and span calibration checks performed daily? Yes ___ No ___
_____ Are drift values within performance specification requirements? Yes ___ No ___

SOURCE TRS CEM SYSTEM REVIEW

DATE _____ SOURCE CONTACT _____

1 - Review records and update inspection procedures.
Note all items to which unsatisfactory responses were received. Discuss each with source representative via telephone and note status below.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

2 - Request copies of unreduced CEM system output including diluent gas and process parameter measurements necessary for conversion to emission rate which correspond to:
- o an excess emission,
- o a CEM system malfunction or outage, and
- o an interval of time during which no excess emission or CEM system malfunction occurred as determined by the EER review.

3 - Request a copy of CEM maintenance log corresponding to a CEM system malfunction and/or outage reported in EER.

4 - Request copies of zero and span calibration (generally shown on strip chart) check.
After receiving the requested information reduce CEM data to units of emission standard and compare to corresponding emission rates submitted on EER. Refer to appropriate subpart of 40 CFR 60, 40 CFR 51 Appendix P, operating permit or enforcement action for proper data reduction procedure and conversion factor. Review CEM output during reported process downtime, CEM calibration and monitor malfunction.

ACTION REQUIRED

_____ Are EER and agency calculated excess emission rates the same? Yes ___ No ___

_____ Do agency calculations of data not reported as excess emissions indicate compliance? Yes ___ No ___

_____ Was CEM malfunction or outage caused by component or subsystem failure? Yes ___ No ___

_____ Was CEM outage scheduled for preventive maintenance? Yes ___ No ___

_____ Do source maintenance and operating records indicate monitor status and corrective action during outage? Yes ___ No ___

Which if any of the following caused the outage:
- Calibration gas supply,
- Optical surface condition,
- Conditioning system,
- Air purge system,
- Optical alignment,
- Light source,
- Other (describe) _____

_____

ceding page blank

ACTION REQUIRED

5 - TRS CEM SYSTEM INSTALLATION INSPECTION

____	Is CEM sampling point in a nonstratified location (for gas monitors)?	Yes ___	No ___
	If so, how was non-stratification verified? _____		
____	If stratification exists, does sampling method and location of diluent gas sampling interface provide measurement of representative sample?	Yes ___	No ___
____	Is R.M. sampling point as close as possible to CEM sampling point?	Yes ___	No ___
	Describe access to sampling point. _____		
____	Are CEM sampling and analyzing components free of excessive vibration and extreme ambient temperatures?	Yes ___	No ___
	Describe location of calibration gas bottles (if used). _____		
____	Are transport and conditioning systems designed and installed properly to deliver sample which meets analyzer requirements (temperature, wet, dry etc)? Refer to manufacturer's operation/maintenance manual	Yes ___	No ___
____	Is calibration gas introduced at or near the sample interface at the proper pressure?	Yes ___	No ___
____	Are control panel and recorder located in a controlled environment?	Yes ___	No ___
____	Is purge air supply clean and dry?	Yes ___	No ___

Transport line details - Conditioning System

CEM SYSTEM OPERATION OBSERVATION

____	Does calibration check indicate satisfactory drift?	Yes ___	No ___
____	Is automatic zero compensation employed?	Yes ___	No ___
____	If so, is zero compensation greater than 4% (opacity only) or does reference indicator (if used) show TRS CEM system zero signal to be within specified tolerance of zero reference signal?	Yes ___	No ___
____	If calibration gases are used, are they introduced to the TRS CEM system at the sampling interface?	Yes ___	No ___
____	Are calibration references (gas cell, gas cylinder, neutral density filter) of the appropriate value?	Yes ___	No ___

ACTION REQUIRED

____	Is recorder span set at value required by the appropriate subpart of 40 CFR 60, or by SIP?	Yes ___	No ___
____	Is pollutant concentration easily determined from recording device?	Yes ___	No ___
____	Is a zero offset employed?	Yes ___	No ___
	If not, how is negative zero drift quantified? _____		
	_____		
____	Are any fault indications displayed on control panel?	Yes ___	No ___
	If so, discuss. _____		
	_____		
	_____		

3 - CEM PROGRAM EVALUATION

____	Is an alarm connected to TRS CEM control panel to signal excess emissions?	Yes ___	No ___
	How often is CEM output checked by an operator? _____		
	What procedures are implemented during an excess emission incident to reduce emissions? _____		
	_____		
	_____		
	Are process data measurements conducted according to the methods described in applicable NSPS/SIP regulation or permit?	Yes ___	No ___
____	Are changes in calibration reference materials (gas, cell, filter) documented?	Yes ___	No ___
____	How and how often is emission data reviewed for validity by the source? _____		
____	Are entries into Maintenance and Operations Logs made in relation to monitor:		
	Malfunctions	Yes ___	No ___
	Calibrations	Yes ___	No ___
	Maintenance	Yes ___	No ___
	QA Checks	Yes ___	No ___

APPENDIX

Preceding page blank

Conversion Factors

International Metric System: Le Systeme International d'Unites (SI Units)

Base Units of the International Metric System (SI)		
Quantity	**Name of the Unit**	**Symbol**
Length	meter	m
Mass	kilogram	kg
Time	second	s
Temperature	Kelvin	K
Amount of substance	mole	mol

Recommended decimal multiples and submultiples and the corresponding prefixes and names.

Factor	Prefix	Symbol	Meaning
10^{12}	tera	T	One trillion times
10^{9}	giga	G	One billion times
10^{6}	mega	M	One million times
10^{3}	kilo	k	One thousand times
10^{2}	hecto	h	One hundred times
10	deca	da	Ten times
10^{-1}	deci	d	One tenth of
10^{-2}	centi	c	One hundredth of
10^{-3}	milli	m	One thousandth of
10^{-6}	micro	μ	One millionth of
10^{-9}	nano	n	One billionth of
10^{-12}	pico	p	One trillionth of
10^{-15}	femto	f	One quadrillionth of
10^{-18}	atto	a	One quintillionth of

Preceding page blank

Conversion from ppm to g/m³ at STP

$$T_{std} = 273.15\,°K$$

$$P_{std} = 1\ atm$$

$$\frac{g}{dscm} = \frac{ppm \times M.W. \left(\frac{g}{g\text{-mole}}\right)}{22.414 \frac{liters}{g\text{-mole}} \times 10^{-3} \frac{m^3}{10^3 L} \left(\frac{293.15\,°K}{273.15\,°K}\right)} \times \frac{1}{1 \times 10^6\ ppm}$$

Atomic Weights and Numbers

Name	Symbol	Atomic Number	Atomic Weight
Arsenic	As	33	74.9216
Barium	Ba	56	137.34
Cadmium	Cd	48	112.40
Carbon	C	6	12.01115
Chlorine	Cl	17	35.453
Hydrogen	H	1	1.00797
Iodine	I	53	126.9044
Lead	Pb	82	207.19
Nitrogen	N	7	14.0067
Oxygen	O	8	15.9994
Phosphorous	P	15	30.9738
Potassium	K	19	39.102
Sodium	Na	11	22.9898
Sulfur	S	16	32.064

FIELD NOTES

FIELD NOTES

FIELD NOTES

FIELD NOTES

FIELD NOTES

FIELD NOTES